Work Order ID 70306

Thursday, June 02, 2011 2:51:42 PM

Item ID: D206-667-203TRN **Accept** **Setup Start**

Revision ID: **Stop**

Item Name: Crosstube Turning Detail

Start Date: 6/2/2011 **Start Qty:** 1.00 **Cust Item ID:**

Required Date: 6/17/2011 **Req'd Qty:** 1.00 **Customer:**

Reference:

Approvals: **Process Plan:** CL **Date:** 11/06/02 **Tooling:** _____ **Date:** _____ **Run Start**

QC: _____ **Date:** _____ **SPC (Y/N):** _____ **Date:** _____ **Stop**

Sequence ID/ Work Center ID	Operation Description	Set Up/ Run Hours	Tool ID	Tool #	Plan Code	Accept Qty	Reject Qty	Reject Number	Insp. Stamp
Draw Nbr	**Revision Nbr**								
D206-667-243	Rev C								
100	MORI SEIKI CNC LATHE LARGE	0.00				1	0		
Mori Seiki	**Memo**	0.00							
Mori Seiki CNC Lathe Large	1-Fill tube with sand & install plugs DT8534 on both ends as per Folio FA089 2-Turn first side as per Folio FA089 3-Blend transition lines only, **do not sand whole tube**: *Use mill bastard file, brush file repeatedly with file card. *Do not use sandpaper coarser than 320 grit.								MM 11/06/02
110	QC1- Inspect dimensions to dimension sheet	0.00				1			
QC	**Memo**	0.00							ark 11/07/04
Quality Control									

Dart Aerospace Ltd

W/O:	WORK ORDER CHANGES						
DATE	STEP	PROCEDURE CHANGE	By	Date	Qty	Approval Chief Eng / Prod Mgr	Approval QC Inspector

Part No: D206-667-203TRN PAR #: N/A. Fault Category: Machining NCR: (Yes) No DQA: [illegible] Date: 11.07.11

11-703 Resolution: Use-as-is Disposition: Use-as-is QA: N/C Closed: _____ Date: _____

NCR: 70306	WORK ORDER NON-CONFORMANCE (NCR)							
DATE	STEP	Description of NC Section A	Corrective Action Section B			Verification Section C	Approval Chief Eng	Approval QC Inspector
			Initial Chief Eng	Action Description Chief Eng	Sign & Date			
11.07.04	100	O.D. up to 0.004" below tolerance. Cuff length is below tolerance R.C Program	11.07.04	M.S. still positive per attached S.R. Acceptable.	11/07/04	11/07/04	11.07.04 042	11/07/04

NOTE: Date & initial all entries

Work Order ID 70306

Thursday, June 02, 2011 2:51:42 PM

Item ID: D206-667-203TRN **Accept** **Setup Start** **Stop**

Revision ID:

Item Name: Crosstube Turning Detail

Start Date: 6/2/2011 **Start Qty:** 1.00 **Cust Item ID:**

Required Date: 6/17/2011 **Req'd Qty:** 1.00 **Customer:**

Reference:

Run Start **Stop**

Approvals: **Process Plan:** _____ **Date:** _____ **Tooling:** _____ **Date:** _____

QC: _____ **Date:** _____ **SPC (Y/N):** _____ **Date:** _____

Sequence ID/ Work Center ID	Operation Description	Set Up/ Run Hours	Tool ID	Tool #	Plan Code	Accept Qty	Reject Qty	Reject Number	Insp. Stamp
120		0.00							
Mori Seiki	MORI SEIKI CNC LATHE LARGE					1	0		
Mori Seiki CNC Lathe Large	**Memo**	0.00							
	1-Turn second side as per Folio FA089 2-Blend transition lines only, **do not sand whole tube**: *Use mill bastard file, brush file repeatedly with file card. *Do not use sandpaper coarser than 320 grit. 3-Remove sand and plugs 4-Scrib part# and batch #								
130	QC1- Inspect dimensions to dimension sheet	0.00							
QC	**Memo**	0.00							
Quality Control									

MCM 11/06/23

mk 11/07/04

Dart Aerospace Ltd

W/O:		WORK ORDER CHANGES					
DATE	**STEP**	**PROCEDURE CHANGE**	**By**	**Date**	**Qty**	**Approval** Chief Eng / Prod Mgr	**Approval** QC Inspector

Part No: _____ **PAR #:** _____ **Fault Category:** _____ **NCR:** Yes No **DQA:** _____ **Date:** _____

Resolution: _____ **Disposition:** _____ **QA: N/C Closed:** _____ **Date:** _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	**STEP**	**Description of NC** Section A	**Corrective Action** Section B			**Verification** Section C	**Approval** Chief Eng	**Approval** QC Inspector
			Initial Chief Eng	**Action Description** Chief Eng	**Sign & Date**			

NOTE: Date & initial all entries

Work Order ID 70306

Thursday, June 02, 2011 2:51:42 PM

Item ID: D206-667-203TRN **Accept** **Setup Start** **Stop**

Revision ID:

Item Name: Crosstube Turning Detail

Start Date: 6/2/2011 **Start Qty:** 1.00 **Cust Item ID:**

Required Date: 6/17/2011 **Req'd Qty:** 1.00 **Customer:**

Reference:

Run Start **Stop**

Approvals: **Process Plan:** _____ **Date:** _____ **Tooling:** _____ **Date:** _____

QC: _____ **Date:** _____ **SPC (Y/N):** _____ **Date:** _____

Sequence ID/ Work Center ID	Operation Description	Set Up/ Run Hours	Tool ID	Tool #	Plan Code	Accept Qty	Reject Qty	Reject Number	Insp. Stamp
140	QC8- Inspect parts - second check	0.00	B.A 11/07/04			1	0		
QC	**Memo**	0.00							
Quality Control									
150	Crosstubes Chemical Conversion	0.00	JW BE 11-06-05						
HandFXtube	**Memo**	0.00							
Hand Finishing Crosstubes									
160	QC3- Inspect Part Finish	0.00	11-7-5						
QC	**Memo**	0.00							
Quality Control									

Dart Aerospace Ltd

W/O:		WORK ORDER CHANGES					
DATE	**STEP**	**PROCEDURE CHANGE**	**By**	**Date**	**Qty**	**Approval** Chief Eng / Prod Mgr	**Approval** QC Inspector

Part No: _____ **PAR #:** _____ **Fault Category:** _____ **NCR:** Yes No **DQA:** _____ **Date:** _____

Resolution: _____ **Disposition:** _____ **QA: N/C Closed:** _____ **Date:** _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	**STEP**	**Description of NC** Section A	**Corrective Action** Section B			**Verification** Section C	**Approval** Chief Eng	**Approval** QC Inspector
			Initial Chief Eng	**Action Description** Chief Eng	**Sign & Date**			

NOTE: Date & initial all entries

Picklist Print

Thursday, June 02, 2011 2:51:40 PM

Work Order ID: 70306

Parent Item: D206-667-203TRN

Parent Item Name: Crosstube Turning Detail

Start Date: 6/2/2011 **Required Date:** 6/17/2011

Start Qty: 1.00 **Required Qty:** 1.00

Work Order ID 70306

Thursday, June 02, 2011 2:51:42 PM

Item ID: D206-667-203TRN **Accept** **Setup Start** **Stop**

Revision ID:

Item Name: Crosstube Turning Detail

Start Date: 6/2/2011 **Start Qty:** 1.00 **Cust Item ID:**

Required Date: 6/17/2011 **Req'd Qty:** 1.00 **Customer:**

Reference:

Run Start **Stop**

Approvals: **Process Plan:** _____ **Date:** _____ **Tooling:** _____ **Date:** _____

QC: _____ **Date:** _____ **SPC (Y/N):** _____ **Date:** _____

Sequence ID/ Work Center ID	Operation Description	Set Up/ Run Hours	Tool ID	Tool #	Plan Code	Accept Qty	Reject Qty	Reject Number	Insp. Stamp
170	Packaging	0.00							
Packaging	**Memo**	0.00							
Packaging	Identify and Stock in kanban rack☐Location:								

JW 11-06-05 LG

180	QC21- Final Inspection - Work Order Release	0.00							
QC	**Memo**	0.00							
Quality Control									

11/7/5

MF 11-07-05

Dart Aerospace Ltd

W/O:		WORK ORDER CHANGES					
DATE	**STEP**	**PROCEDURE CHANGE**	**By**	**Date**	**Qty**	**Approval** Chief Eng / Prod Mgr	**Approval** QC Inspector

Dart Aerospace Ltd

W/O:		WORK ORDER CHANGES					
DATE	**STEP**	**PROCEDURE CHANGE**	**By**	**Date**	**Qty**	**Approval** Chief Eng / Prod Mgr	**Approval** QC Inspector

Part No: _____ **PAR #:** _____ **Fault Category:** _____ **NCR:** Yes No **DQA:** _____ **Date:** _____

Resolution: _____ **Disposition:** _____ **QA: N/C Closed:** _____ **Date:** _____

NCR:		WORK ORDER NON-CONFORMANCE (NCR)						
DATE	**STEP**	**Description of NC** Section A	**Corrective Action** Section B			**Verification** Section C	**Approval** Chief Eng	**Approval** QC Inspector
			Initial Chief Eng	**Action Description** Chief Eng	**Sign & Date**			

NOTE: Date & initial all entries

DART AEROSPACE LTD		Work Order:	70306
Description: Crosstube Assembly		Part Number:	D206-667-243
Inspection Dwg: D206-667-243 Rev: C			Page 1 of 1

FIRST ARTICLE INSPECTION CHECKLIST

	Inspection Sheet Drawing Dimension	Tolerance	Actual Dimension	Accept	Reject	Method of Inspection	Comments
SIDE A	2.490	+0.005/-0.000	2.493	✓		mic	JF-01
	2.018	+0.005/-0.000	2.023	✓		"	
	2.079	+0.005/-0.000	2.083	✓		"	
	2.145	+0.005/-0.000	2.148	✓		"	
	2.209	+0.005/-0.000	2.13	✓		"	
	2.287	+0.005/-0.000	2.287	✓		"	
	2.363	+0.005/-0.000	2.363	✓		"	
	2.433	+0.005/-0.000	2.437	✓		"	
	0.200	+/-0.010	.200	✓		vern	JF-01
	0.500 x 30°	+/-0.010	.500 x 30	✓		"	
	R0.063	+/-0.010	.063	✓		RG	
	R0.500	+/-0.010	.500	✓		"	
	4.438	+/-0.030	4.400				
SIDE B	104.91	+/-0.020	104.92	✓		tape	MM.L-02
	2.490	+0.005/-0.000	2.492	✓			
	2.018	+0.005/-0.000	2.021	✓			
	2.079	+0.005/-0.000	2.081	✓			
	2.145	+0.005/-0.000	2.147	✓			
	2.209	+0.005/-0.000	2.212	✓			
	2.287	+0.005/-0.000	2.290	✓			
	2.363	+0.005/-0.000	2.366	✓		→ 2.361	(after transition has been filed down)
	2.433	+0.005/-0.000	2.436	✓			
	0.200	+/-0.010	.205	✓		vern	JF-01
	0.500 x 30°	+/-0.010	.500 x 30	✓		"	
	R0.063	+/-0.010	.063	✓		RG	
	R0.500	+/-0.010	.500	✓		"	
	4.438	+/-0.030	4.395	✓	✓	vern	JF-01

Measured by:	MM.L/JF	Audited by:	K.A	Preliminary Approval:	N/A
Date:	11/06/23	Date:	11/07/04	Date:	N/A

Rev	Date	Change	Revised by	Approved
A	06.09.01	New Issue (P/O D206-667-203)	KJ/JLM	
B	10.08.25	Dwg Rev updated	KJ	

Item	Qty -243	Part Number	Description
1	X	D206-667-243	CROSSTUBE ASSEMBLY (206L HIGH AFT)
2	1	D6004-115	CROSSTUBE
3	2	D2873-043	NUT PLATE
4	2	D2873-045	NUT PLATE
5	2	D2892-1	SUPPORT
6	4	D3595-063-450	RUBBER CUSHION
7	4	MS21920-22	CLAMP
8	14	MS20601AD4W10	RIVET (OR NAS9302B-4-10)
9	A/R	MAGNOBOND 6398	ROCKWELL SPECIFICATION RBO-120-023 ADHESIVE (TEXTRON/BELL SPEC. 299-947-100, TYPE II, CLASS 2 ADHESIVE)

CL111006/02

W10: 70306

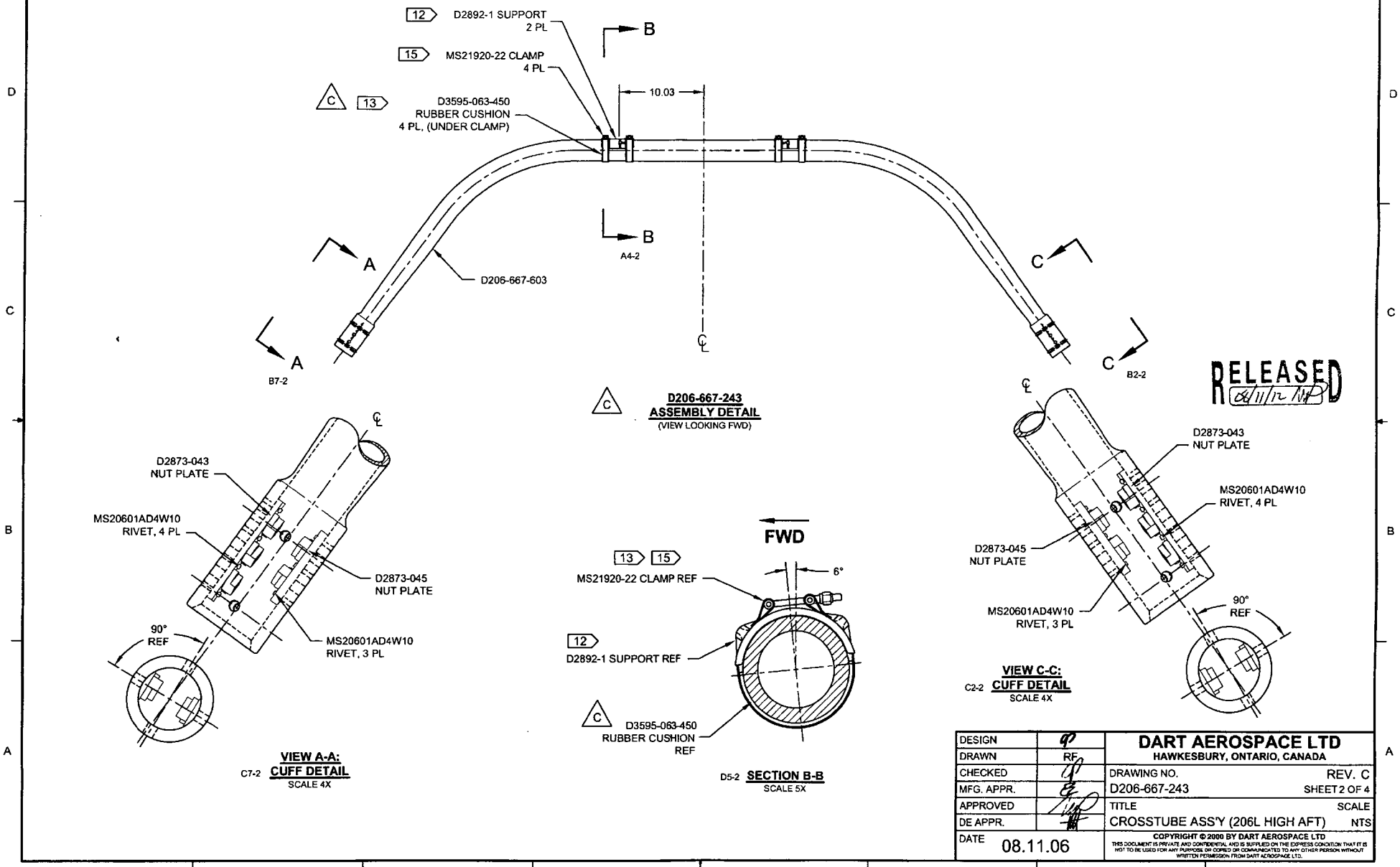
GENERAL NOTES:

1) MATERIAL: MANUFACTURED FROM D6004-115
   FINISHED LENGTH = 104.91±0.020
2) FINISH: CHEMICAL CONVERSION COAT PER DART QSI 005 4.1
   PRIME INSIDE AND OUTSIDE PER DART QSI 005 4.2
   PAINT OUTSIDE PER DART QSI 005 4.2
3) TOLERANCES ARE PER DART QSI 018 UNLESS OTHERWISE NOTED.
4) UNITS: INCHES UNLESS OTHERWISE NOTED.
5) BREAK SHARP EDGES: 0.005 TO 0.010 MAX.
6) IDENTIFICATION: SCRIBE DART PART NUMBER "D206-667-243" AND BATCH NUMBER ON INSIDE OF CUFF USING VIBRATING STYLUS.
7) WEIGHT: 21.9 lbs
8) PART IS SYMMETRIC ABOUT CENTERLINE.
9) RUN CUTTER OFF PART WHERE INDICATED. BLEND OUT EDGE LONGITUDINALLY, TRANSITION SHOULD BE SMOOTH.
10) BEND PROGRESSIVELY WITH A MINIMUM OF 8 PASSES. MAXIMUM TUBE FLATTENING DUE TO BENDING IS 6% BASED ON O.D.
11) LIQUID PENETRANT INSPECT OUTSIDE SURFACE OF CROSSTUBE PER QSI 038.
12) INSTALL D2892-1 SUPPORT USING 0.03" TO 0.06" THICK LAYER OF MAGNOBOND 6398 PER QSI 015. LET CURE FOR 12 HOURS AFTER INSTALLATION AND PRIOR TO PACKAGING.
13) INSTALL MS21920-22 CLAMPS WITH D3595-063-450 RUBBER CUSHIONS TO SECURE THE D2892-1 SUPPORT ON TOP SIDE OF THE CROSSTUBE. ENSURE CLAMP MECHANISMS ARE LOCATED ON CROSSTUBE SUPPORTS.
14) EXTREME CARE MUST BE TAKEN TO PROTECT THE OUTSIDE SURFACE OF THE TUBE. THE OUTSIDE SURFACE MUST BE SMOOTH AND FREE FROM SURFACE DEFECTS SUCH AS SCRATCHES, NICKS, OR DENTS. DEFECTS UP TO 0.005" MAY BE BLENDED OUT LONGITUDINALLY. CIRCUMFERENTIAL GRIND MARKS ARE UNACCEPTABLE.
15) TORQUE CLAMPS 80 TO 100 IN-LB. ENSURE AT LEAST 1.5 THREADS ARE SHOWING IN SAFETY AND THAT NUT HAS NOT BOTTOMED-OUT AFTER TORQUING.

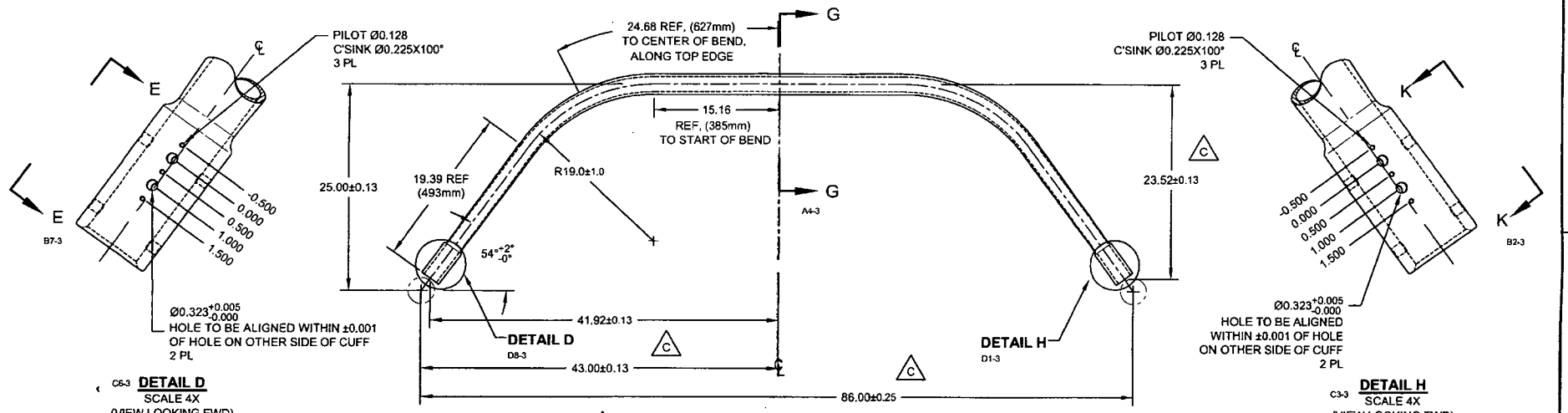
RELEASED 08/11/06 MM

REV.	DESCRIPTION	BY	DATE
C	REVISE GENERAL NOTES/PART LIST (ZN D7-1); REORGANIZED VIEWS AND REFORMATTED DRAWING TO CURRENT STANDARDS. D3595-063-450 WAS D2856-400-773 (ZN D6-2 & A5-2); REMOVED REF. & ADD TOLERANCES (ZN 4-3, C5-3, D3-3); RELOCATED FLAG #6 (ZN A8-3) PER NCR 210; MOVED TURNING DETAIL & UPDATED TOLERANCE TO SHEET 4.	RF	08.11.06
B	ADD HOLES AND NUT PLATES FOR COMPATABILITY WITH BHT/AA SKUDTUBES	PH	05.07.26
A	NEW ISSUE	CP	00.11.17

DESIGN	QP	**DART AEROSPACE LTD** HAWKESBURY, ONTARIO, CANADA	
DRAWN	RF		
CHECKED		DRAWING NO.	REV. C
MFG. APPR.		D206-667-243	SHEET 1 OF 4
APPROVED		TITLE	SCALE
DE APPR.		CROSSTUBE ASS'Y (206L HIGH AFT)	NTS
DATE	08.11.06		



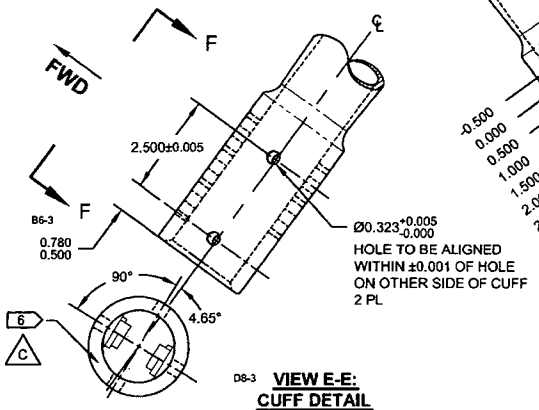
DESIGN		DART AEROSPACE LTD HAWKESBURY, ONTARIO, CANADA
DRAWN	RF	
CHECKED		DRAWING NO. REV. C
MFG. APPR.		D206-667-243 SHEET 2 OF 4
APPROVED		TITLE SCALE
DE APPR.		CROSSTUBE ASS'Y (206L HIGH AFT) NTS
DATE	08.11.06	



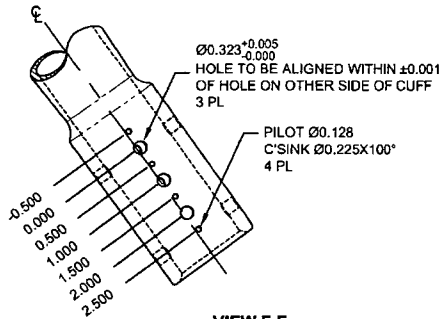
C6-3 **DETAIL D**
SCALE 4X
(VIEW LOOKING FWD)

C3-3 **DETAIL H**
SCALE 4X
(VIEW LOOKING FWD)

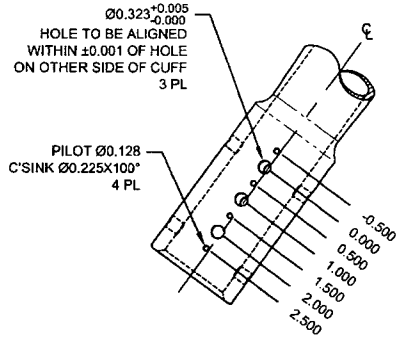
D206-667-603
BENDING AND DRILLING DETAIL
(VIEW LOOKING FWD)



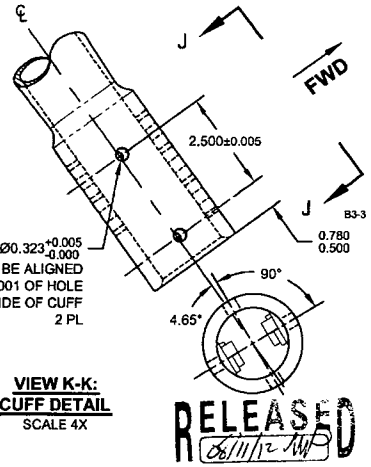
D8-3 **VIEW E-E:**
CUFF DETAIL
SCALE 4X



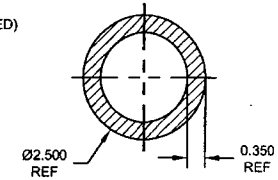
B7-3 **VIEW F-F**
(VIEW LOOKING AFT, ROTATED)



B2-3 **VIEW J-J**
(VIEW LOOKING AFT, ROTATED)



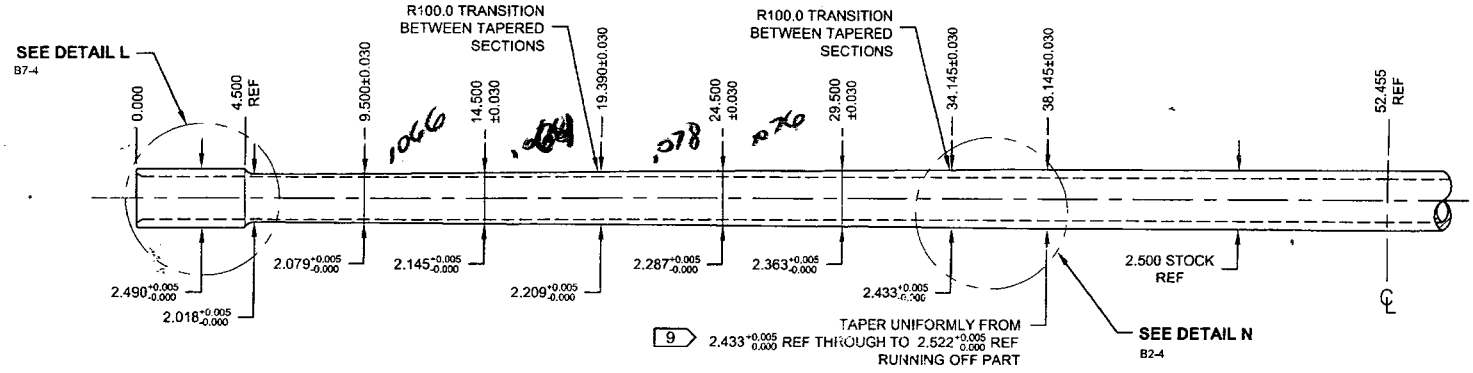
D1-3 **VIEW K-K:**
CUFF DETAIL
SCALE 4X



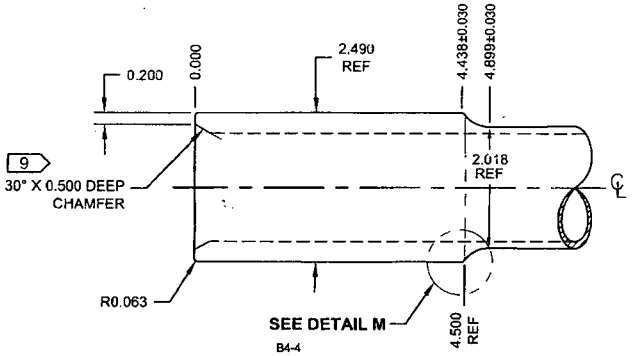
D4-3 **SECTION G-G**
SCALE 5X

RELEASED
08/11/12

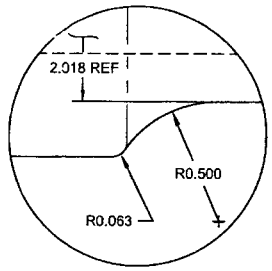
DESIGN		**DART AEROSPACE LTD**
DRAWN	RF	HAWKESBURY, ONTARIO, CANADA
CHECKED		DRAWING NO. REV. C
MFG. APPR.		D206-667-243 SHEET 3 OF 4
APPROVED		TITLE SCALE
DE APPR.		CROSSTUBE ASS'Y (206L HIGH AFT) NTS
DATE	08.11.06	



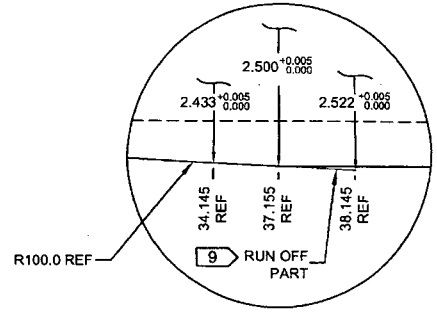
C **TURNING DETAIL**



C7-4 **DETAIL L: CROSSTUBE CUFF**
NOT TO SCALE



B6-4 **DETAIL M: CUFF TRANSITION**
NOT TO SCALE



C4-4 **DETAIL N: TAPER RUN-OFF**
NOT TO SCALE

RELEASED 08/11/12

DESIGN		**DART AEROSPACE LTD** HAWKESBURY, ONTARIO, CANADA
DRAWN	RF	
CHECKED		DRAWING NO. D206-667-243 REV. C SHEET 4 OF 4
MFG. APPR.		
APPROVED		TITLE CROSSTUBE ASS'Y (206L HIGH AFT) SCALE NTS
DE APPR.		
DATE 08.11.06		

3.3 Aft Crosstube Comparison

The Dart aft crosstube is defined by drawing D206-667-243. The Bell aft crosstube dimension are based on data from BHT-206L3-MM-5 (Ref 1, page 5). The relative locations of the sections used in this comparison are shown in Figure 4 (on page 7). Table 2 gives the cross-sectional properties of the Bell and Dart crosstubes at locations that correspond to changes in taper of the Dart crosstubes.

Table 2: Aft High-Gear Crosstube Cross-sections

SECTION	Cross tube	Damage Tolerance	O.D. (in)	I.D. (in)	Area (in^2)	Inertia (in^4)
A-A	Bell Aft	0.000	2.500	1.820	2.307	1.379
	Bell Aft w/ dam. tol.	0.005			2.302	1.371
	Dart Aft	0.000	2.500	1.800	2.364	1.402
	Dart Aft w/ dam. tol.	0.015			2.246	1.332
B-B	Bell Aft	0.000	2.422	1.820	2.006	1.151
	Bell Aft w/ dam. tol.	0.005			2.001	1.143
	Dart Aft	0.000	2.413	1.800	2.028	1.149
	Dart Aft w/ dam. tol.	0.015			1.911	1.080
C-C	Bell Aft	0.000	2.357	1.820	1.762	0.976
	Bell Aft w/ dam. tol.	0.005			1.757	0.969
	Dart Aft	0.000	2.345	1.800	1.774	0.969
	Dart Aft w/ dam. tol.	0.015	2.341		1.656	(0.901) → 0.890
D-D	Bell Aft	0.000	2.291	1.820	1.521	0.814
	Bell Aft w/ dam. tol.	0.005			1.516	0.807
	Dart Aft	0.000	2.277	1.800	1.527	0.804
	Dart Aft w/ dam. tol.	0.015			1.410	0.738
E-E	Bell Aft	0.000	2.226	1.820	1.290	0.667
	Bell Aft w/ dam. tol.	0.005			1.285	0.660
	Dart Aft	0.000	2.209	1.800	1.288	0.654
	Dart Aft w/ dam. tol.	0.015			1.170	0.588
F-F	Bell Aft	0.000	2.117	1.820	0.918	0.447
	Bell Aft w/ dam. tol.	0.005			0.913	0.442
	Dart Aft	0.000	2.113	1.800	0.962	0.463
	Dart Aft w/ dam. tol.	0.015			0.861	0.399
G-G	Bell Aft	0.000	2.008	1.820	0.565	0.259
	Bell Aft w/ dam. tol.	0.005			0.560	0.254
	Dart Aft	0.000	2.018	1.800	0.654	0.299
	Dart Aft w/ dam. tol.	0.015			0.553	0.236
H-H	Bell Aft	0.000	2.500	1.820	2.307	1.379
	Bell Aft w/ dam. tol.	0.005			2.302	1.371
	Dart Aft	0.000	2.490	1.800	2.325	1.372
	Dart Aft w/ dam. tol.	0.030			2.192	1.301

4.3 Aft Crosstube Strength Comparison (refer to Table 2 on page 9)

Table 4: Aft High-Gear Crosstube Strength Comparison

SECTION **	Cross tube	Bending Ultimate (lb*in)	Bending Yield (lb*in)	Tension Ultimate (lb)	Tension Yield (lb)	Shear Ultimate (lb)
A-A	Bell aft w/ DT	72393	61424	151944	128922	96692
	Dart aft w/ DT	82041	70745	172963	148254	92097
	Margin of Safety	0.13	0.15	0.14	0.15	-0.05
B-B	Bell aft w/ DT	62306	52866	132043	112037	84028
	Dart aft w/ DT	68918	59442	147114	126097	78333
	Margin of Safety	0.11	0.12	0.11	0.13	-0.07
C-C	Bell aft w/ DT	54293	46067	115941	98374	73781
	Dart aft w/ DT	59187	51059	127547	109326	67915
	Margin of Safety	0.09	0.11	0.10	0.11	-0.08
D-D	Bell aft w/ DT	46505	39459	100040	84882	63662
	Dart aft w/ DT	49887	43044	108540	93034	57794
	Margin of Safety	0.07	0.09	0.08	0.10	-0.09
E-E	Bell aft w/ DT	39164	33230	84820	71969	53976
	Dart aft w/ DT	40996	35380	90092	77222	47971
	Margin of Safety	0.05	0.06	0.06	0.07	-0.11
F-F	Bell aft w/ DT	27545	23371	60282	51148	38361
	Dart aft w/ DT	29101	25122	66328	56852	35317
	Margin of Safety	0.06	0.07	0.10	0.11	-0.08
G-G	Bell aft w/ DT	16724	14190	36975	31372	23529
	Dart aft w/ DT	18033	15573	42595	36510	22680
	Margin of Safety	0.08	0.10	0.15	0.16	-0.04
H-H	Bell fwd w/ DT	72393	61424	151944	128922	96692
	Dart fwd w/ DT	80479	69400	168790	144677	89875
	Margin of Safety	0.11	0.13	0.11	0.12	-0.07

58,464

M.S. = 0.07

*The negative shear margins are addressed in Section 4.7

**for Section A-A, the worst case corresponds to min stock OD instead of max stock OD, so the calculation is slightly different then the sample calculation presented in section 4.1

M.S. still positive with 0.089" smaller O.D.

11.07.04